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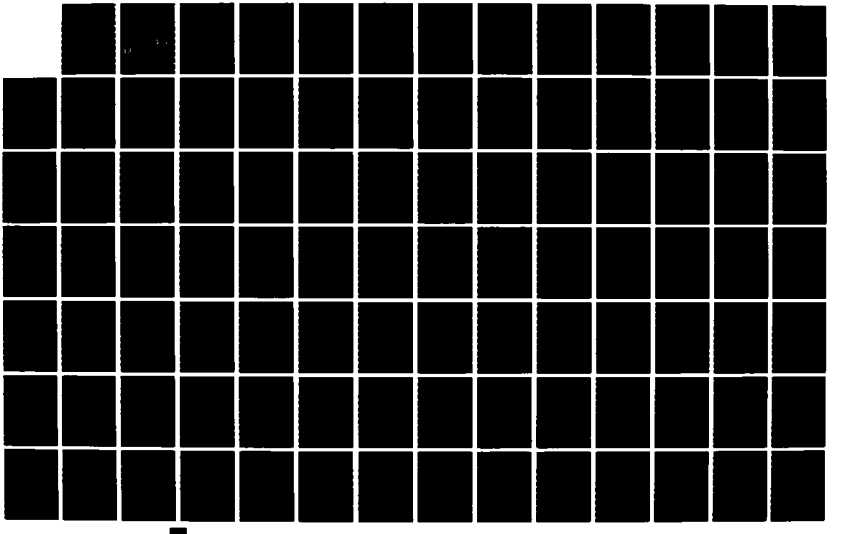

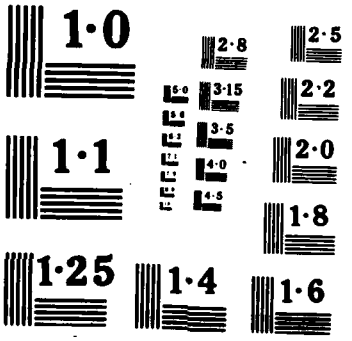
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INDEX TO BENET WEAPONS LABORATORY TECHNICAL REPORTS - 1985

R. D. NEIFELD

TECHNICAL PUBLICATIONS AND EDITING UNIT

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US ARMY ARMAMENT RESEARCH AND DEVELOPMENT CENTER
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Per Ms. R. D. Neifeld, Benet Weapons Lab., ATTN: SMCAR-CCB-TL

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ARCCB-TR-85003	Computer Model for the Solidification of Composition B	J.D. Vasilakis	Dec 85
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Amorphous Metals
Electron-Phonon Interaction
Electrical Transport

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Electrical transport in amorphous metals is analyzed in the context of the Baym-Faber-Ziman theory. The theory is generalized to incorporate electron mean free path effects through the Pippard-Ziman condition on the electron-phonon interaction. A variety of model t-matrices are considered. The geometrical structure factors are modeled by Percus-Yevick hard sphere forms and a single branch Debye phonon spectrum is assumed. Detailed results for electrical

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20. ABSTRACT (CONT'D)

resistivity ρ vs. temperature T and the TCR are presented for extensive ranges of $2k_F/k_p$ and electron mean free path. The results, incorporating the Pippard-Ziman condition, are consistent with the observed ρ vs. T in low resistivity glassy metals. However, although inclusion of the Pippard-Ziman condition dramatically improves agreement with the data, quantitative agreement is not obtained in high resistivity amorphous metals.

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REPORT DOCUMENTATION PAGE

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3. RECIPIENT'S CATALOG NUMBER	
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Solid Metal Induced Embrittlement
Fracture in Solid Metal Environments
Effects of Stress, Time, and Temperature on Embrittlement
Mechanisms of Solid Metal Embrittlement

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Many ductile metals in intimate contact with thin coatings of low melting solid metal which exhibit liquid metal embrittlement, also manifest severe embrittlement when tested at temperatures below the melting point of the coating. A significant decrease in stress, strain, and reduction-in-area occurs at fracture. Fracture propagates fast, but at a rate which is one or two orders of magnitude slower than that in liquid metal environments. Fracture occurs by

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20. ABSTRACT (CONT'D)

brittle intergranular or transcrystalline mode with multiple cracks and branching. This new phenomena is known as solid metal induced embrittlement of metals (SMIE). SMIE also occurs when the embrittling metal is present as an internal environment in the base metal such as inclusions. This report describes the occurrence of SMIE in metals and alloys used in industry and presents results of recent investigations. It describes the effects of time, temperature, and stress on SMIE. It discusses the occurrence, the mechanisms of SMIE, and its similarity to LME. This new phenomena must be considered while investigating environmentally induced failure of failure analysis of metals and alloys.

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4. TITLE *(and Subtitle)* THE FATIGUE EFFECTS OF THE M119A1 ZONE 8 ROUND ON THE 155 MM M199 HOWITZER TUBE		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Bruce B. Brown		8. CONTRACT OR GRANT NUMBER(s)
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18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

155 mm M198 Howitzer System
155 mm M199 Howitzer Tube
Fatigue
Safe Service Life
Equivalent Full Charge Factor
EFC
M203 Propellant Charge
M119A1 Propellant Charge
M4A2 Propellant Charge

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The safe service life of the 155 mm M199 howitzer tube has previously been established based on the M203 Zone 8 propellant charge. This study was conducted to evaluate the effects of a lower pressure propelling charge, the M119A1 Zone 8, on the tube fatigue life. Testing and analysis were based on the 'worst case' mix of the two pressure levels to determine an Equivalent Full Charge (EFC) factor for the M119A1 Zone 8 charge. An Equivalent Full Charge
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20. ABSTRACT (CONT'D)

factor of 0.25 is recommended for the M119A1 Zone 8 charge in the 155 mm M199 howitzer tube. From other available data, this same EFC factor is recommended for the M119A2 Zone 7 and M4A2 Zone 7 charges.

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1. REPORT NUMBER ARLCB-TR-85004	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* FATIGUE PERFORMANCE OF 105 MM M68 TUBE UNDER DIFFERING PRESSURE CONDITIONS		5. TYPE OF REPORT & PERIOD COVERED Final 6 PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Bruce B. Brown		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 2080.15.6000.0 PRON No. 1A1221B81A1A
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18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Fatigue
Expected Safe Life
105 mm M68
Tank Gun
Equivalent Full Charge

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This test program was conducted to assess the effects of fatigue over a span of pressures which would be encountered when the 105 mm M68 tank gun is fired using differing round types. Previous tests had established the failure mode locations and safe life for the standard M735 (APFSDS-T) round at maximum service temperature, and these data are included in the analysis. The new tests were at pressures above and below this level such that the analysis has resulted in an expected safe life curve available for Equivalent Full Charge (EFC) factor assignment to round types whose pressures fall within this span.

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7. AUTHOR(s) L. V. Meisel and P. J. Cote		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.02.H600.011 PRON No. 1A325B541A1A
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Disordered Metals
Thermal Expansion
Electrical Transport

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Theoretical treatments of electrical transport in amorphous metals are usually performed at constant volume, although most experimental studies are performed at constant pressure. Recent studies of the influence of pressure on the electrical resistivity of a variety of amorphous metals indicate that thermal expansion effects can not be ignored in a theoretical description of the temperature dependence of the isobaric resistivity. In this report, general

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20. ABSTRACT (CONT'D)

ideas pertinent to a theoretical description of non-isochoric electrical transport are presented. Results for isobaric electrical transport based on the Gruneisen theory of thermal expansion, which are independent of the model employed to treat isochoric transport, are also given. The implications of the theory are illustrated in the context of the diffraction model by: (1) detailed results specific to the well-characterized low resistivity alloy, a-Mg_7Zn_3; and (2) a selection of model calculations incorporating thermal expansion effects for cases with positive and negative pressure coefficients of resistivity.

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4. TITLE *(and Subtitle)* CYCLIC TORSION OF A CIRCULAR CYLINDER AND ITS RESIDUAL STRESS DISTRIBUTION		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR*(s)* Han C. Wu, M. R. Aboutorabi, and Peter C. T. Chen (see reverse)		8. CONTRACT OR GRANT NUMBER*(s)*
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17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

To be published in ASME Journal of Engineering Materials and Technology.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Circular Cylinder
Cyclic Torsion
Residual Stresses
Endochronic Theory of Plasticity

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The endochronic theory of plasticity is applied to discuss the cyclic fully-reversed torsional loading of a solid bar with circular cross-section. Numerical techniques are employed to obtain the solution. The parameters of the constitutive equations are determined from the test data of thin-walled specimens. These parameters are then used without alteration to compute stress distributions within the solid specimen. Special attention is given to the
(CONT'D ON REVERSE)

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SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

7. AUTHORS (CONT'D)

Han C. Wu (Professor) and M. R. Aboutorabi (Graduate Student)
Department of Civil Engineering
University of Iowa
Iowa City, Iowa 52242

20. ABSTRACT (CONT'D)

residual stress distribution. It is shown that reasonable results are obtained. The relation of torque versus strain at the outermost fiber of the solid specimen provides an ultimate check of the theory as applied to this case.

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ARLCB-TR-85007
2. GOVT ACCESSION NO.:
3. RECIPIENT'S CATALOG NUMBER:

4. TITLE (and Subtitle): A MORE ACCURATE SOLUTION TO THE ELASTIC-PLASTIC PROBLEM OF PRESSURIZED THICK-WALLED CYLINDERS

5. TYPE OF REPORT & PERIOD COVERED: Final

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): Peter C. T. Chen

8. CONTRACT OR GRANT NUMBER(s):

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Watervliet, NY 12189-5000

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18. SUPPLEMENTARY NOTES

Presented at the Second Army Conference on Applied Math & Computing, RPI, Troy, NY, 22-24 May 1984. Published in the Conference Proceedings.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Strain-Hardening Materials
Pressurized Thick-Walled Cylinders
Residual Stresses
Finite-Difference Method

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A new method has been developed for solving the partially plastic problems of thick-walled cylinders made of strain-hardening or ideally-plastic materials subjected to any combination of internal pressure, external pressure, and end loads. The incremental strains are chosen as the basic unknowns in the finite-difference formulation. The incremental sizes of the applied loading are determined automatically and no iteration is needed. Complete solutions
(CONT'D ON REVERSE)

20. ABSTRACT (CONT'D)

for the stresses, strains, and displacement have been obtained and all numerical results are very accurate. This approach is also efficient and simple, yet quite general, when compared with many solutions in the literature.

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1. REPORT NUMBER ARLCB-TR-85008	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) WEAR OF PROJECTILE ROTATING BANDS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) R. S. Montgomery		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS NO.6111.02.H600.011 PRON NO. 1A325B541A1A
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Melt-Lubricating Rotating Bands Projectile Wear Cannon Bores Body Engraving Interior Ballistics		

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Rotating or driving bands are bands of relatively soft materials surrounding a projectile. They have a number of functions the chief of which is probably that they produce stabilizing rotating of the projectile when they are "engraved" or keyed into the rifling. These bands are used on spin-stabilized projectiles as small as 20 mm caliber, but this discussion concerns especially the larger cannon, i.e., in excess of 105 mm. Excess wear of projectile

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20. ABSTRACT (CONT'D)

rotating bands has a number of important negative consequences including inaccuracy and "short rounds". There are two distinctly different mechanisms of wear. At low speeds near the beginning of motion, wear is by adhesion, abrasion, and even under some conditions, scuffing. After a few centimeters of sliding, a thin surface film of molten band material is formed and the remainder of the sliding is melt-lubricated. While metal-on-metal sliding is limited to the first few centimeters, it is very important and can result in serious wear problems down bore. The exact wear of rotating bands depends on the motion of the projectile in the bore of the cannon. Therefore, this motion can be inferred from the wear.

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-SP-85009	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) PROCEEDINGS, FOURTH U.S. ARMY SYMPOSIUM ON GUN DYNAMICS VOL.I of II VOLS.		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Editors: Dr. T. E. Simkins Dr. J. Vasilakis		8. CONTRACT OR GRANT NUMBER(s)
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11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801-5001		12. REPORT DATE May 1985 13. NUMBER OF PAGES 292
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18. SUPPLEMENTARY NOTES

Presented at the Fourth U.S. Army Symposium on Gun Dynamics, 7-9 May 1985, at the Hilton Inn of the Palm Beaches, Riviera Beach, Florida.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Acquisition
Ballistics
Barrel Vibration
Dynamics
Precision
Stabilization
Target Acquisition

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This represents a compilation of thirty-four technical papers concerning analyses, design, measurement, and automation of gun dynamics. The authors represent a cross-section of the scientific and technical community, including universities, industrial, and Government research laboratories.

REPORT DOCUMENTATION PAGE

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7. AUTHOR(s): Editors: Dr. T. E. Simkins, Dr. J. Vasilakis

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Ballistics
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Stabilization
Target Acquisition

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

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1. REPORT NUMBER ARLCB-TR-85010	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) SHEAR DEFLECTION IN A THREE-POINT BEND BEAM OF A SOLID CIRCULAR CROSS-SECTION		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Boaz Avitzur		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3111.16.0003.600 PRON No. 1A227D111A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801-5001		12. REPORT DATE March 1985 13. NUMBER OF PAGES 11
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Deflection
Shear Stresses
Circular Beams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An equation, correlating the elastic deflection of a simply supported beam of a circular cross-section, with the applied load and beam's material properties and dimensions is being offered here. The contributions due to the bending moment and due to shear stresses are computed and compared.

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER: ARLCB-TR-85011	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): STRESS CONCENTRATION IN THE ELASTOPLASTIC STATE AND RESIDUAL STRESS AFTER UNLOADING	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Y. F. Cheng	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 6111.02.H600.011 PRON No. 1A425M541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801-5001	12. REPORT DATE: March 1985 13. NUMBER OF PAGES: 32
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18. SUPPLEMENTARY NOTES

Presented at 1984 Army Symposium on Solid Mechanics, Newport, Rhode Island, 1-3 October 1984.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Photoelasticity	Elastoplastic State
Photoplasticity	Stress Concentration
Photoelastic Coating	Residual Stress

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Photoplasticity and photoelastic coating techniques have been successfully employed to study stress concentration in the elastoplastic state and residual stress after unloading. Principles are described herein, and examples of the application of both methods are given. The results show that stress concentration in the elastoplastic state is lower than that in the elastic state and decreases continuously as yielding progresses. A good agreement exists between results from both methods.

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-85012	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) AUTONOMOUS DETECTION OF OBJECTS FROM RANGE DATA MEASUREMENTS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Ronald L. Racicot and C. N. Shen		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.01.91A0.011 PRON No. 1A425M511A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801-5001		12. REPORT DATE April 1985 13. NUMBER OF PAGES 16
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18. SUPPLEMENTARY NOTES

Presented at Mini and Microcomputers in Control, Filtering & Signal Processing Conference, Caesars Palace, Las Vegas, Nevada, 10-12 December 1984.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Vision Systems
Laser Rangefinder
Object Detection
Kalman Filter

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The overall objective of this study is to provide autonomous detection of obstacles or objects within a given field of view using noisy range data measurements as might be obtained from a laser rangefinder. Specifically, the goal is to provide simplified and efficient computer procedures suitable for filtering and processing the range data to detect objects. The particular procedure studied involves a single term state vector (range) with adaptive

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20. ABSTRACT (CONT'D)

procedures for handling objects on a sloped plane. The range data is processed by incrementally varying elevation angle for fixed azimuth angle. The edges of objects are detected using a Bayesian decision procedure on the filtered range data.

Results are presented showing the minimum object size that can be detected as a function of false alarm rate, Bayesian decision criteria, measurement noise level, and covariances of the artificial noise levels added to the filter to minimize false alarms. The artificial noise covariances can be either in the form of system (plant) noise or measurement noise. Results indicate that the most efficient approach to minimizing false alarms in terms of minimizing detectable object size is to adjust the Bayesian decision criteria. The least efficient approach is to artificially add system noise covariances.

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1. REPORT NUMBER ARLCB-TR-85013	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* FRACTURE IN LIQUID METAL ENVIRONMENTS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) M. H. Kamdar		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS NO. 6910.00.H840.021 Pron NO. 1A425Q781A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801-5001		12. REPORT DATE April 1985 13. NUMBER OF PAGES 56
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18. SUPPLEMENTARY NOTES

Presented at the Sixth International Fracture Conference, New Delhi, India, 4 December, 1984.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Fracture in Liquid Metals
Liquid Metal Embrittlement
Effects of Metallurgical, Mechanical, Chemical Parameters
Mechanisms of Embrittlement

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Many ductile metals fracture in a brittle manner when tested in the presence of a thin surface coating of certain liquid metals. The severity of embrittlement depends upon the metallurgical, mechanical, and physical factors and also on the chemical nature of the liquid and the solute dissolved in the liquid metals. Liquid metal embrittlement is considered a special case of brittle fracture and it is generally accepted that embrittlement is caused by the liquid metal "Adsorption Induced Reductions in the Cohesion" of atomic bonds at the crack
(CONT'D ON REVERSE)

20. ABSTRACT (CONT'D)

tip. This report describes the phenomena of fracture in liquid metal environments and discusses the effects of variables related to the solid, the liquid, the liquid metal solutions, and to the test conditions on the severity of embrittlement. It also discusses various mechanisms of embrittlement. Also, a summary with suggestions for future work is presented.

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-85014	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* FRACTURE TESTING WITH ARC BEND SPECIMENS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. H. Underwood, J. A. Kapp, and M. D. Witherell		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS NO. 6940.0R.2200.0 Pron NO. 1A323G471A1A
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18. SUPPLEMENTARY NOTES

Presented at the 17th National Symposium on Fracture Mechanics, Albany,N.Y. 7-9 August, 1985, Albany Hilton.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Fracture Toughness
Specimen Design
Cylindrical Geometry
Bend Specimen
Stress Analysis

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A limited review of existing stress, stress intensity factor, and displacement analyses is compared with new work in order to select arc bend geometries appropriate for fracture testing. Results from the literature for rectangular and arc bend specimens are compared with finite element and boundary collocation results from the present work.

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20. ABSTRACT (CONT'D)

Two series of comparative tests were performed, one with arc specimens cut from a steel forging with outer-to-inner radius ratio of 2.5, the other from an aluminum cylinder with outer-to-inner radius ratio of 1.3. Fracture toughness tests, K_{Ic} and J_{Ic}, when appropriate, were performed with standard arc tension specimens and with three-point arc bend specimens both arc and chord support.

Conclusions were drawn regarding the appropriate stress intensity factor, crack mouth displacement, and load-line displacement solutions for arc bend fracture specimens. Recommendations were offered for practical ranges of specimen geometry and for reliable test procedures.

REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER: ARLCB-MR-85015	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): MORE ON COMPLIANCE OF THE THREE-POINT BEND SPECIMEN	5. TYPE OF REPORT & PERIOD COVERED: Final
6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s): John H. Underwood, Joseph A. Kapp, and Francis I. Baratta (AMMRC)	8. CONTRACT OR GRANT NUMBER(s)
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18. SUPPLEMENTARY NOTES

Submitted to International Journal of Fracture.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Fracture Test Methods
Load-Line Displacement
Bend Specimen

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Comparison and analysis of load-line displacement for the three-point bend specimen was performed. Expressions were developed for displacement as a function of crack length and for crack length as a function of displacement.

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-85016	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A MESH MOVING TECHNIQUE FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS IN TWO SPACE DIMENSIONS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) David C. Arney and Joseph E. Flaherty (see reverse)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.01.011 PRON No. 1A425M51A1A
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Adaptive Methods
Hyperbolic Partial Differential Equations
Mesh Moving
Finite Volume

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
We discuss an adaptive mesh moving technique that can be used with a finite difference or finite element scheme to solve initial-boundary value problems for vector systems or partial differential equations in two space dimensions and time. The mesh moving technique is based on an algebraic node movement function determined from the propagation of significant error regions. The algorithm is designed to be flexible, so that it can be used with many existing
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7. AUTHOR(S) (CONT'D)

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20. ABSTRACT (CONT'D)

finite difference and finite element methods. To test the algorithm, we implemented the mesh mover in a system code along with an initial mesh generator and a MacCormack finite volume integrator on quadralateral cells to solve hyperbolic vector systems. Results are presented for several computational examples. This moving mesh reduces dispersion errors near shocks and wave fronts and thereby reduces the grid requirements necessary to compute accurate solutions while increasing efficiency.

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-85017	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* NEW POWDER TECHNOLOGIES FOR MOLYBDENUM ALLOY GUN BARREL LINERS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. M. Barranco and Saul Isserow (see reverse)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6910.00.H840.021 PRON No. 1A425Q781A1A
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18. SUPPLEMENTARY NOTES

Presented at Powder Metallurgy in Defense Technology Seminar, AMCCOM, Dover, New Jersey, 24-26 September 1984.
Published in Seminar Proceedings.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Molybdenum Alloy Powder
Gun Barrel Liner
Hot Isostatic Pressing
Bend Rupture Strength
Compression Strength

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Molybdenum is an attractive material for resisting gun barrel erosion because of its high melting point and mechanical properties. In previous efforts, molybdenum has been unsatisfactory because of the coarse grains and strong anisotropy in conventionally processed material. Powder metallurgy offers the opportunity to overcome these deficiencies. New technologies for preparing and consolidating powders are therefore being investigated to permit
(CONT'D ON REVERSE)

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7. AUTHORS (CONT'D)

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20. ABSTRACT (CONT'D)

utilization of the benefits of molybdenum for this and related applications. Work will be reported on alloy powders prepared by various methods with emphasis on rapid solidification, either by rotating electrode (REP and PREP) or by plasma melting (PMRS, plasma melted rapidly solidified). To date, consolidation has been primarily by hot isostatic pressing (HIP).

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1. REPORT NUMBER ARLCB-TR-85018	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) STRESS INTENSITY FACTORS AT RADIAL CRACKS OF UNEQUAL DEPTH IN PARTIALLY AUTOFRETTAGED, PRESSURIZED CYLINDERS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) S. L. Pu		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.02.H600.011 PRON No. 1A425M541A1A
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Stress Intensity Factors
Multiple Cracks
Autofrettaged Cylinders
Cracks of Unequal Lengths
Fracture Mechanics

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Stress intensity factors are estimated for radial cracks of unequal depths emanating from the inner surface of a partially autofrettaged cylinder subjected to various bore pressures. The approximate method developed for uneven radial cracks in a non-autofrettaged cylinder is applied to functional stress intensities. Linear superposition is then used to obtain the final stress intensity factors of uneven cracks due to a stress field which varies

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20. ABSTRACT (CONT'D)

with the magnitude of bore pressure, the degree of autofrettage, and the elastic-plastic behavior of the cylinder material. The autofrettage residual stress reduces the level of stress intensity factors at inner radial cracks due to internal pressure, but has little effect on variations in stress intensity factors caused by changes in crack depths.

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1. REPORT NUMBER ARLCB-TR-85019	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) DYNAMIC RESPONSE IN AN ELASTIC-PLASTIC PROJECTILE DUE TO NORMAL IMPACT		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) P. C. T. Chen, J. E. Flaherty, and J. D. Vasilakis		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.01.91A0.011 PRON No. 1A425M511A1A
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Elastic-Plastic Analysis
Projectile Impact
Finite Elements
ADINA
Different Integration Schemes

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A numerical study of the dynamic response of an elastic-plastic projectile due to normal impact has been made using the finite element structural response code ADINA. The projectile is a finite length circular cylindrical bar striking a rigid target. First, three (central-difference, Newmark, Wilson) direct integration schemes have been used for the uniaxial stress wave problem in a linear-hardening material, and the results are compared with an exact

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20. ABSTRACT (CONT'D)

analytical solution in order to evaluate accuracy and stability. Then, additional nmerical results for perfectly-plastic materials are discussed in order to show the effect of strain-hardening. Finally, some results for a multi-linear material model based on two-dimensional elements are presented in order to show the lateral effect.

REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER: ARLCB-TR-85020	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): ELECTROLYTIC DEBURRING OF BORE EVACUATOR HOLES IN SMOOTH BORE CYLINDERS	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): V. P. Greco, J. Barnes, and R. Siska	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Center, Benet Weapons Laboratory, SMCAR-LCB-TL, Watervliet, NY 12189-5000	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 3297.06.8346.1, PRON No. 1A227D311A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Center, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801-5001	12. REPORT DATE: June 1985
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Electrodeburring
Electropolishing of Small Holes
Chromium Deposits
Nodules
Chipping of Deposits
Sharp Corners
Erosion of Bore Evacuator Holes

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The sharp corners of evacuator holes in gun bores stimulate chromium buildup and nodular growth of the deposit during plating. This results from the formation of high current density gradients along any protrusions of a surface due to the poor throwing power of the electrolyte. This condition causes excessive chipping of the chromium deposit during early stages of firing. With the removal of chromium, rapid erosion of the base metal occurs due to

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20. ABSTRACT (CONT'D)

undermining of the hot propellant gases leading to early condemnation of the gun tube.

The use of a mechanical tool to round off the sharp corners prior to plating was unsatisfactory and electrochemical machining was not practical. The application of an electrochemical deburring technique using an electropolishing electrolyte has been found to be most successful and is reported here. The use of specially designed electrodes and associated apparatus for deburring the corners of small holes is described and the resulting profiles are shown.

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1. REPORT NUMBER ARLCB-TR-85021	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* VARIATIONAL PRINCIPLE FOR PENETRATOR DYNAMICS USING BILINEAR FUNCTIONAL AND ADJOINT FORMULATION		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) C. N. Shen		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.01.91A0.011 PRON No. 1A425M511A1A
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18. SUPPLEMENTARY NOTES

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Published in Conference Proceedings.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Variational Principle
Penetrator Dynamics
Matrix Vector Coupling Systems
Adjoint System
Optimization

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The solution to problems in both spatial and time domains using the finite element method can be based on the variational principle employing bilinear functional and adjoint formulation. This principle is extended to matrix vector coupling systems such as in penetration dynamics. The present hyperbolic type partial differential equation of interest has two dependent and two independent variables with the coupling in the spatial domain.

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1. REPORT NUMBER: ARLCB-TR-85022	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: RECURSIVE GRADIENT ESTIMATION USING SPLINES FOR NAVIGATION OF AUTONOMOUS VEHICLES	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): C. N. Shen	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Center, Benet Weapons Laboratory, SMCAR-LCB-TL, Watervliet, NY 12189-5000	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 6111.01.91A0.011, PRON No. 1A425M511A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Center, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801-5001	12. REPORT DATE: July 1985
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19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Terrain Slope Estimation
Autonomous Vehicle Navigation
Two-Dimensional Recursive Smoothing
Polynomial Splines
Laser Range Matrix

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Terrain gradient estimation is needed for navigation of an autonomous vehicle in climbing the hills. The in-path and cross-path terrain slopes are estimated from the set of corresponding range slopes. A two-dimensional recursive smoothing algorithm using polynomial splines in the third dimension is developed for this purpose. Approximations are introduced in the sub-optimal system so that the computation time increases only linearly with the size of the two-dimensional data.

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1. REPORT NUMBER ARLCB-SP-85023	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* INDEX TO BENET WEAPONS LABORATORY (LCWSL) TECHNICAL REPORTS - 1984		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) R. D. Neifeld		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801-5001		12. REPORT DATE July 1985 13. NUMBER OF PAGES 105
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19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

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Technical Publications
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Abstracts
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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

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1. REPORT NUMBER ARLCB-CR-85024	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* DEVELOPMENT OF A COMPUTER-AIDED THERMAL ANALYSIS FOR AN IMPROVED 155mm HOWITZER RECOIL MECHANISM		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) CPT J. M. McMurray and COL M. A. Paolino		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Military Academy Department of Mechanics West Point, NY 10996		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801-5001		12. REPORT DATE July 1985 13. NUMBER OF PAGES 47
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18. SUPPLEMENTARY NOTES

Ronald G. Gast - Benet Weapons Laboratory Project Engineer

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Recoil Mechanism	Howitzer
Thermal Analysis	Radiation
Computer-Aided	Convection

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A computer program was developed which models the energy transfer in a 155mm howitzer recoil mechanism. The program also predicts the temperature-time history in the recoil mechanism components. A worst case firing scenario of a repetitive five minute cycle, involving six rounds fired in one minute, followed by four idle minutes is utilized. The recoil mechanism is modeled by considering each of the components in the recoil mechanism as a lumped-

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20. ABSTRACT (CONT'D)

parameter node. After a simulated round is fired, and during the four idle minutes, an energy balance is made between all nodes. Energy transfer by radiation and convection is considered. The rise in the temperature of each node is calculated from the energy absorbed. Numerical results obtained from the computer program show that unacceptable temperatures will be reached in the recoil mechanism unless forced-convection heat transfer cooling is used. A mechanical scheme for incorporating forced-convection cooling is suggested and predicted temperatures are presented.

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1. REPORT NUMBER ARLCB-TR-85025	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* THE DENSIFICATION OF MOLYBDENUM AND MOLYBDENUM ALLOY POWDERS USING HOT ISOSTATIC PRESSING		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. Barranco, I. Ahmad, S. Isserow, and R. Warenchak (See reverse)		8. CONTRACT OR GRANT NUMBER(s)
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11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801-5001		12. REPORT DATE August 1985 13. NUMBER OF PAGES 59
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18. SUPPLEMENTARY NOTES

Presented at TMS-AIME Fall Meeting, Detroit, Michigan, 16-20 September 1984.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Powder Metallurgy
Molybdenum Alloys
Hot Isostatic Pressing
Mechanical Properties

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This study was conducted to determine a superior erosion resistant gun barrel liner material with improved properties at higher temperatures. Four categories of powders were examined:

1. TZM spherical containing 0.5 titanium, 0.08 zirconium, and 0.02 carbon (wt. % nominally), balance molybdenum (Mo), produced by REP ((Rotating

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7. AUTHORS (CONT'D)

Saul Isserow
Army Materials and Mechanics Research Center
Watertown, MA 02172

20. ABSTRACT (CONT'D)

Electrode Process), PREP (Plasma Rotating Electrode Process), and PMRS (Plasma Melted and Rapidly Solidified);
2. Mo reduced 2 and 5 μm;
3. Mo-0.1% cobalt, co-reduced;
4. Mo-5 wt. % alumina (Al_2O_3), dispersion strengthened.

Hot Isostatic Pressing (HIP) densification occurred at 15-30 Ksi, 1300-1600°C, for 1.5 to 3.0 hours. The TZM REP/PREP powders (220/74 μm) were not fully densified even at 1600°C, 30 Ksi, 3 hours. Point particle contact prevented complete void elimination. TZM PMRS powder (24.7 μm) achieved 99 percent of theoretical density while maintaining a small grain size (10.4 ASTM eq.) Bend deflection and fracture energies were approximately three times those for PREP powder at a bend rupture strength of about 120 Ksi. Mo reduced and Mo-0.1% Co powders showed less (or the same) ductility with increasing HIP temperatures. Fractures were intergranular with decreased bend rupture and compression strength. The Mo-5Al_2O_3 powder maintained a fine grain size (13 ASTM eq.), but with fracture energies usually less than 0.6 in.-lbs. Included are results from bending and compression testing with metallographic and fracture mode interpretation.

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1. REPORT NUMBER ARLCB-TR-85026	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) TERRAIN SCENE ANALYSIS AND OBSTACLE RECONSTRUCTION FOR NAVIGATION OF MOBILE ROBOTS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) C. N. Shen (See Reverse)		8. CONTRACT OR GRANT NUMBER(s)
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18. SUPPLEMENTARY NOTES

Presented at the Conference on Intelligent Systems and Machines, Oakland University, Rochester, MI, 24-25 April, 1984.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Terrrain Scene Analysis
Object Reconstruction
Robot Navigation
Surface Slopes
Three-Dimensional Space Curves

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

For a robot to be able to perform a task in a dynamic workscene, it must be able to identify the objects in the scene. To achieve this objective, a form of sight must be provided. The first stage in achieving sight is the collection of visual input data. This input is in the form of depth information, such as that received from a laser range finder.

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7. AUTHOR (CONT'D)

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20. ABSTRACT (CONT'D)

The laser range finder for a mobile robot is mounted on a mast from which a noisy measurement matrix is generated. This range matrix has a grid with azimuth angles as its abscissa and elevation angles as its ordinates. With these noisy measurements, a rapid estimation scheme is used to det[illegible]he presence of horizontal and vertical edges on a terrain by processi[illegible] range data successively along each column and row of the range matrix. Ma[illegible] points in a three-dimensional space are generated by estimating sudden change in the range and range slopes using detection scheme with a decision tree. The result of the estimation is a collection of data points to form a curve in space that belongs to some edge of an obstacle from the vantage point where the laser range finder is located. The orthogonal surface slopes of an obstacle can be determined from the range slopes which are estimated from the range matrix. The segmentation of range data on the basis of surface slopes provides groups of connected data points that belong to one particular face of some observed obstacles. The problem of grouping range data points of different planar surfaces on the basis of their surface slopes becomes an application of clustering analysis.

A data clustering and surface fitting operation must be performed and the location of edges and vertices must be determined. Objects are then assembled from these surfaces, edges, and vertices. There are no a priori knowledge of the number of objects in the workscene, however, it is assumed that all the objects in the scene can be approximated modeled as having many planar surfaces. Limitations of a sight system depend on the form of input data used. Systems such as laser range finder systems, which use range information directly, cannot determine edges between objects which are in close alignment. Clearly none of these input data styles can determine the scene description perfectly; therefore, any object recognition scheme would strive for consistency.

The first approach of a heuristic scheme for object reconstruction and formation is presented here based on input data containing depth information. This scheme will reconstruct plane faceted objects from a workscene described as edges, faces, and vertices in cartesian coordinates. The set of heuristic rules is based on geometric considerations and insight into the characteristics of objects, which are found to be the convexity and colinearity of edges. Methods for determining if an edge is convex or concave and if two edges are colinear are developed. These methods are consistent, regardless of the viewer's point of observation. If parts of the image of the workscene in the input information exhibit certain properties, then these parts will be grouped as an object.

Unclassified

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-85027	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* DEFLECTION IN TAPERED CANTILEVER BEAMS DEFLECTION (GAP OPENING) IN DOUBLE CANTILEVER TYPE FRACTURE TOUGHNESS SPECIMENS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Boaz Avitzur		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 7280.12.12.000 PRON No. 1A423M891A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801-5001		12. REPORT DATE August 1985 13. NUMBER OF PAGES 38
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

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17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Gap Opening
Fracture Toughness
Tapered Beam

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

When an otherwise homogeneous material under stress contains small defects (i.e., internal cracks and/or voids), the stresses at parts of the material-defect interface significantly exceed the ones anticipated at that location in the absence of such irregularities. Consequently, a structural member, otherwise calculated to safely sustain the applied loads, might unpredictably fail. That branch of engineering which intends to account for such 'stress-raisers' is known as fracture mechanics. Fracture mechanics studies have found that

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20. ABSTRACT (CONT'D)

different materials (and even the same material when loaded in different orientations) reflect different sensitivity to such 'stress-raisers'--a material property known as fracture toughness. Test samples and testing procedures have been devised in order to quantify this material property. The relation between the applied load and its displacement (or gap opening) at the point of crack growth is being used herein to determine (compute) material fracture toughness.

While the equations derived for the stress field near the edge of a defect in an otherwise uniform field assume an infinite volume of material to surround the (relatively) very small defect, the crack to width and/or height in these laboratory size testing samples is definitely a finite one. This report offers a mathematical relation between the applied load and that part of the deflection (gap opening) which is due to the cantilever-like part of the sample, for that class of fracture toughness test specimens which can be described as double cantilever. A beam theory approach is used.

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-85028	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A LOCAL REFINEMENT FINITE ELEMENT METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Joseph E. Flaherty and Peter K. Moore (See Reverse)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS NO.6111.01.91A0.011 PRON NO. 1A425M51A1A
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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES Presented at the Second Conference on Applied Math and Computing, 22-25 May 1984, RPI, Troy, New York.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Finite Element Method
Partial Differential Equations
Space-Time Elements
Local Refinement
Adaptive Methods

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

We discuss an adaptive local refinement finite element method for solving initial-boundary value problems for vector systems of partial differential equations in one space dimension and time. The method uses piecewise bilinear rectangular space-time finite elements. For each time step, grids are automatically added to regions where the local discretization error is estimated as being larger than a prescribed tolerance. We discuss several
(CONT'D ON REVERSE)

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7. AUTHORS (CONT'D)

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20. ABSTRACT (CONT'D)

aspects of our algorithm, including the tree structure that is used to represent the finite element solution and grids, an error estimation technique, and initial and boundary conditions at coarse-fine mesh interfaces. We also present computational results for a simple linear hyperbolic problem, a problem involving Burgers' equation, and a model combustion problem.

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-85029	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* ANALYSIS OF ELASTIC-PLASTIC BALL INDENTATION TO MEASURE STRENGTH OF HIGH STRENGTH STEELS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. H. Underwood, G. P. O'Hara, and J. J. Zalinka		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 5397.0M.6350.100 PRON No. 1A527P591A1A
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18. SUPPLEMENTARY NOTES

Presented at 1985 SEM Spring Conference on Experimental Mechanics, Research-in-Progress Session, Las Vegas, NV, 9-13 June 1985.
Submitted for publication in Experimental Mechanics.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Ball Contact	Hardness
Indentation	Elastic-Plastic
High Strength Steel	Slip-Line Field
Ultimate Strength	

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Ball indentation experiments were performed with A723 steel of 1000 to 1200 MPa ultimate strength. Results were compared with conventional tension tests and with an elastic-plastic finite element model of the ball indentation. Finite element analysis showed the ball indentation process to be insensitive to friction effects. Comparison of indentation and conventional tests showed that slip-line field analysis closely predicts the ball contact stress. Indentation tests gave an accurate measure of ultimate tensile strength under the following
(CONT'D ON REVERSE)

20. ABSTRACT (CONT'D)

conditions: using a large ball size and a fixed ratio of indentation depth to ball size; ignoring initial ball contact; accounting for directional material properties; accounting for extraneous system deflections.

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-85030	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Machinability Data Bases for MetalCutting		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Major Walter W. Olson		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research and Development Center Benet Weapons Laboratory, DRSMC-LCB-TL Watervliet, NY 12189 - 5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 665808-E860035 DA Project 6837724 PRON No. M7-3-F1900-M7-1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Center Large Caliber Weapon System Laboratory Dover, New Jersey 07801-5001		12. REPORT DATE September 1985 13. NUMBER OF PAGES 26
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Machinability
Material properties for machining
Tool wear
Data Base Structures

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Machinability date bases are discussed with respect to content, form and methods. Machinability data is needed to implement the factory of the future. Therefore, data sources and current formulas are featured in addition to formation of structures.

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER: ARLCB-MR-85031	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): FATIGUE TESTS OF TWO 105 MM L119 BRITISH LIGHT GUN BREECH RINGS AND BREECH BLOCKS	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): R. R. Lasselle	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Center, Benet Weapons Laboratory, SMCAR-LCB-TL, Watervliet, NY 12189-5000	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 6446.31.2860.012, PRON No. 1A425M921A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Center, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801-5001	12. REPORT DATE: September 1985
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16. DISTRIBUTION STATEMENT (of this Report)

Distribution limited to US Government Agencies only because of test and evaluation; September 1985. Other requests for this document must be referred to Commander, US Army Armament Research and Development Center, ATTN: Benet Weapons Laboratory, SMCAR-LCB-RA, Watervliet, NY 12189.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Cannon
Breech
Breech Ring
Fatigue Test
Dynamic Test

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Fatigue tests of two breech rings and breech blocks of the 105 mm L119 British Light Gun (BLG) are described. The tests were run at 60,000 psi with failures occurring in the jaws of the two breech rings at 9,919 and 14,480 test cycles. Before the laboratory tests, the breeches had been fired 617 rounds and 666 rounds, respectively. A description of the test method is included in this report.

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1. REPORT NUMBER ARLCB-TR-85032	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* ELASTIC-PLASTIC LOADING AND UNLOADING IN A THICK TUBE WITH KINEMATIC HARDENING THEORY		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Peter C. T. Chen		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.02.H600.011 PRON No. 1A52F51D1A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801-5001		12. REPORT DATE September 1985 13. NUMBER OF PAGES 17
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18. SUPPLEMENTARY NOTES

Presented at the Third Army Conference on Applied Mathematics and Computing, Georgia Institute of Technology, Atlanta, Georgia, 13-16 May 1985. Published in Conference Proceedings.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Thick Tube	Kinematic Hardening
Residual Stress	Bauschinger Effect
Elastic-Plastic	Reverse Yelding

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Using Tresca's yield criterion, its associated flow rule, and the linear hardening law, analytical solutions have been obtained for elastic-plastic loading and unloading problems in a thick tube subjected to uniform internal pressure. Explicit expressions for the displacement, strains, and stresses are presented herein, along with numerical results for a closed-end tube.

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1. REPORT NUMBER: ARLCB-SP-85033	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: PROCEDURE FOR ELECTRODEBURRING BORE EVACUATOR HOLES IN 120 MM GUN TUBES (TO IMPROVE THE EROSION RESISTANCE OF CHROMIUM PLATED BORES)	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): V. P. Greco, J. Barnes, and R. Siska	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Center, Benet Weapons Laboratory, SMCAR-LCB-TL, Watervliet, NY 12189-5000	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 3297.06.8346.1, PRON No. 1A227D311A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Center, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801-5001	12. REPORT DATE: September 1985
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17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Electrodeburring
Electropolishing of Small Holes
Chromium Deposits
Nodules
Chipping of Deposits
Sharp Corners
Erosion of Bore Evacuator Holes

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The sharp corners of evacuator holes in gun bores promote formation of high current density gradients during plating due to the poor throwing power of the electrolyte. These high current density gradients stimulate chromium buildup and nodular growth around the sharp edges of the holes during the plating process. This condition causes excessive chipping of the chomium deposit during early stages of firing. With the removal of chromium, rapid erosion of

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20. ABSTRACT (CONT'D)

the base metal occurs due to undermining of the hot propellant gases leading to early condemnation of the gun tube.

An electrochemical deburring technique for rounding off the sharp corners prior to plating has been established and is reported here. Design of a special apparatus and a procedure for its use are described in detail.

Also included are the specifications for the material and equipment, with instructions to construct the apparatus and associated tooling which make up the work kit to deburr the holes.

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER: ARLCB-TR-85034	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): CRACK GROWTH BEHAVIOR OF ALUMINUM ALLOYS TESTED IN LIQUID MERCURY	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): J. A. Kapp, D. J. Duquette (see reverse), and M. H. Kamdar	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Center, Benet Weapons Laboratory, SMCAR-LCB-TL, Watervliet, NY 12189-5000	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 6111.02.H600.011, PRON No. 1A425M541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Armament Research & Development Center, Large Caliber Weapon Systems Laboratory, Dover, NJ 07801-5001	12. REPORT DATE: September 1985
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18. SUPPLEMENTARY NOTES

Presented at ASME Symposium on Crack Growth Behavior of Material Susceptible to Stress Corrosion, New Orleans, LA, December 1984.
Submitted to ASME Journal of Engineering Materials and Technology.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Fracture Mechanics
Liquid Metal Embrittlement
Aluminum Alloys
Mechanisms
Fracture

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Crack growth rate measurements have been made in three mercury embrittled aluminum alloys each under three loading conditions. The alloys were 1100-0, 6061-T651, and 7075-T651. The loading conditions were fixed displacement static loading, fixed load static loading, and fatigue loading at two frequencies. The results showed that mercury cracking of aluminum was not unlike other types of embrittlement (i.e. hydrogen cracking of steels). Under
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7. AUTHORS (CONT'D)

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20. ABSTRACT (CONT'D)

fixed load static conditions no crack growth was observed below a threshold stress intensity factor (K_{ILME}). At K levels greater than K_{ILME} cracks grew on the order of cm/s, while under fixed displacement loading, the crack growth rate was strongly dependent upon the strength of the alloy tested. This was attributed to crack closure. In the fatigue tests, no enhanced crack growth occurred until a critical range of stress intensity factor (ΔK_{th}) was achieved. The ΔK_{th} agreed well with the K_{ILME} obtained from the static tests, but the magnitude of the fatigue growth rate was substantially less than was expected based on the static loading results. Observations of the fracture surfaces in the scanning electron microscope (SEM) suggested a brittle intergranular fracture mode for the 6061-T651 and the 7075-T651 alloys under all loading conditions. The fractographic features of the 1100-0 alloy under fixed load and fatigue loading conditions were also brittle intergranular. Under fixed displacement loading the cracks grew via a ductile intergranular mode.

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-85035	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) PREDICTING CATASTROPHIC OUTSIDE DIAMETER INITIATED FATIGUE FAILURE OF THICK-WALLED CYLINDERS USING LOW CYCLE FATIGUE DATA		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Joseph A. Kapp		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS NO.6111.02.H600.011 PRON NO. 1A325B541A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Large Caliber Weapon Systems Laboratory Dover, NJ 07801-5001		12. REPORT DATE September 1985 13. NUMBER OF PAGES 13
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18. SUPPLEMENTARY NOTES

Presented at the IX Airapt High Pressure Conference, 25-28 July 1983

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Thick-Walled Cylinders	Residual Stress Effects
Fatigue	Predictive Methods
Autofrettage	Pressure Vessels

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A procedure is presented to predict fatigue failure of thick-walled cylinders containing discontinuities at the outside diameter (OD). Both crack initiation life and crack growth are considered. The elastic-plastic strains at an OD discontinuity are estimated using elastic analysis and stress concentration factors. The strain estimates are then used in conjunction with low cycle fatigue data to determine the initiation life. Crack growth life is estimated
(CONT'D ON REVERSE)

20. ABSTRACT (CONT'D)

by integration of a power law relationship. The results obtained by using this analysis method compared to measured fatigue life data for several OD initiated failures in thick-walled cylinders agrees to within about ten percent.

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-85036	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* STRUCTURE OF ELECTRODEPOSITED CHROMIUM ON GUN STEEL		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR*(s)* M. H. Kamdar and R. M. Fisher (see reverse)		8. CONTRACT OR GRANT NUMBER*(s)*
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-LCB-TL Watervliet, NY 12189-5000		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6910.00.H840.021 PRON No. 1A52G5FN1A1A
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14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

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18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Chromium Plating	Grain Size
Cracks	Metallography
Texture	High Voltage Microscopy

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Scanning and transmission electron microscope examination of electrodeposited chromium has revealed that plating conditions affect the size and orientation of the very fine individual crystallites. Plating at 55°C results in a bright, very hard, 1180 Knoop-hardness number (KHN), coating comprised of 0.1 μm diameter grains with a strong <111> fiber texture oriented perpendicular to the surface of the base metal. Plating at higher temperatures such as 85°C, or

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7. AUTHORS (CONT'D)

R. M. Fisher
U.S. Steel Corporation
Research Laboratory
Monroeville, PA 15146

20. ABSTRACT (CONT'D)

with a well-aged plating solution, produces a much softer deposit (600 KHN) composed of 1.5 μm grains with a much less pronounced crystallographic texture. High tensile stresses and the resulting crack formation in the deposit appear to be due to the very large and aligned void space associated with the unequilibrated grain boundaries. Heating during firing or annealing results in one or two percent shrinkage of the chromium as the grain boundary void space is eliminated.

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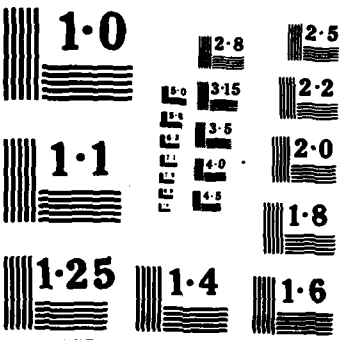
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1. REPORT NUMBER ARLCB-TR-85037	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ASSESSMENT OF J-R CURVES OBTAINED FROM PRECRACKED CHARPY SAMPLES		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. A. Kapp and M. I. Jolles (see reverse)		8. CONTRACT OR GRANT NUMBER(s)
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18. SUPPLEMENTARY NOTES

Presented at 17th National Fracture Mechanics Symposium, Albany, NY, 7-9 August 1984, and published in the Symposium proceedings.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Fracture Testing
Precracked Charpy
J-Integral Testing
Estimated Crack Growth

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

J-R curves were determined for five materials (7075-T651; 2024-T351; HY130; HY80; and A723, Class 1, Grade 4) using precracked Charpy samples and standard size C(T) and SE(B) samples. Crack growth in the Charpy samples was estimated using the "load drop" method of analysis of the load displacement trace, and crack extension in the C(T) and SE(B) specimens was determined using the electric potential method. The results show that physical crack extension in

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7. AUTHORS (CONT'D)

M. I. Jolles
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20. ABSTRACT (CONT'D)

the larger sample was not well estimated by the Charpy sample results. However, if the crack extension is presented as relative crack growth (as a percentage of the uncracked ligament), the agreement between the two widely different specimen sizes is much better, although not exact. With the exception of the relatively brittle 7075-T651, the J corresponding to zero, one percent, and two percent crack growth was higher in the Charpy samples than in the larger samples. This was attributed to the inability of the "load drop" method to determine the exact location of the crack initiation. Although nonconservative, we believe the "load drop" method analysis of precracked Charpy data is adequate for quality control toughness testing provided that it is realized that J_{Ic} and J-R curves may be overestimated slightly.

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1. REPORT NUMBER ARCCB-TR-85001	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) MATERIAL PROPERTY AND FRACTURE TESTING OF 7075-T6 EXTRUDED ALUMINUM		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) M. A. Scavullo, J. H. Underwood, J. A. Kapp, and J. J. Zalinka		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-CCB-TL Watervliet, NY 12189-4050		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 4111.16.2990.0 PRON No. 1A327F751A1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Close Combat Armaments Center Dover, NJ 07801-5001		12. REPORT DATE November 1985 13. NUMBER OF PAGES 21
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Aluminum	Fracture
7075-T6	Sabots
Extrusion	Kinetic Energy Projectiles
Material Properties	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The results of an experimental investigation into the material properties of 7075-T6 extruded aluminum used in the production of sabots for kinetic energy projectiles are presented. A comparison is made of two suppliers' materials, and a test is described that will show a difference exists in the two suppliers' materials.

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4. TITLE (and Subtitle) THE ELECTROPLATING OF LAMINATED CHROMIUM		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) E. S. Chen, G. P. Capsimalis, and G. R. Weigle		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-CCB-TL Watervliet, NY 12189-4050		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.02.H600.011 PRON No. 1A52F51D1A1A
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18. SUPPLEMENTARY NOTES

Presented at 12th International Conference on Metallurgical Coatings, Los Angeles, CA, 15-19 April 1985.

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Electroplating	Laminations
Chromium deposits	Crack Structure
Thermal Expansion	Deposition Orientation
Automated Plating System	Flow Plating

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A microprocessor-controlled flow plating process was developed to deposit laminated chromium consisting of alternating layers of low contraction (LC) an high contraction (HC) chromium. The automated plating system contains a large number of variable parameters designed to allow the use of multiple plating modes. The available modes include a combination of direct current, interrupted, periodic reverse, pulse, and laminated chromium plating.

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18. SUPPLEMENTARY NOTES (CONT'D)

Presented at Electrodeposition Phenomena From Molten Salts Workshop, Imperial College of Science & Technology, London, England, 8-9 July 1985.

To be published in Proceedings of Electrodeposition Workshop.

Submitted to Journal of Electrochemical Society.

20. ABSTRACT (CONT'D)

The laminated plating experiments were conducted at LC/HC solution temperatures of 85 and 55°C, current densities of 120 and 45 A/dm^2, and at LC/HC duty cycles to produce spacings between 0.01 and 2.7 μm. Under these plating conditions, deposits with hardness values between 655 and 1089 KHN and tensile strengths between 6.8 and 57.2 were obtained.

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3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): COMPUTER MODEL FOR THE SOLIDIFICATION OF COMPOSITION B	5. TYPE OF REPORT & PERIOD COVERED: Final
6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s): John D. Vasilakis	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Armament Research & Development Center, Benet Weapons Laboratory, SMCAR-CCB-TL, Watervliet, NY 12189-4050	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMCMS No. 6111.02.H600.011, PRON No. 1A425M541A1A
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Composition B
Solidification Model
Finite Element Analysis
Explosive Compound

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A computer model of an explosive compound, Composition B, solidfying in an M155 mm artillery shell is presented. Shells having been cast with the compound are frequently found with cracks seriously affecting their use. By developing a two-dimensional temperature-dependent model of the solidification process, it is hoped that some of the reasons for the crack initiation can be found. A general purpose finite element program, ADINAT, is used to evaluate

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20. ABSTRACT (CONT'D)

the model. The properties of both the Composition B and steel shell are treated as functions of temperature, and the boundary conditions are considered to be functions of both temperature and time. While the crack initiation cannot be predicted, following the solidification front will give information towards understanding the process. The work will establish the transient temperature distributions and solidification front motions for the various boundary conditions used. An extension of this work, to be performed later, will consider the stresses in the solidfying shell and the residual stress state after solidification is complete.

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4. TITLE *(and Subtitle)* THERMAL SHUTDOWN SYSTEM FOR IBM 4341 COMPUTERS		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR*(s)* Mark Johnson		8. CONTRACT OR GRANT NUMBER*(s)*
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Research & Development Center Benet Weapons Laboratory, SMCAR-CCB-TL Watervliet, NY 12189-4050		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Center Close Combat Armaments Center Dover, NJ 07801-5001		12. REPORT DATE December 1985 13. NUMBER OF PAGES 11
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18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

IBM 4341
Microprocessor
Shutdown
Temperature
Computer

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report describes a thermal shutdown system designed to augment an IBM 4341 processor running the VM/CMS operating system. The microprocessor system monitors room temperature and alerts computer users to an impending shutdown when the temperature becomes too high. A user defined shutdown procedure is then executed prior to powering off the processor and all local peripherals.

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